

## REMARKS

Claims 1-30 remain in the application. Claims 1, 2, 5, 12, 16, 17, 20, and 27 are amended to overcome rejections under 35 USC 112, as discussed below.

The specification is amended to update the status of cited applications at paragraphs 0001 and 0044. The specification is amended to add a missing right parenthesis in paragraph 0113.

The Examiner acknowledges that the present application is a continuation-in-part of application Serial No. 09/844,862, filed April 27, 2001. To complete the record, the '862 application is, in turn, a CIP of application Serial No. 09/823,195, filed March 29, 2001, which in turn is a CIP of application Serial No. 09/759,438, filed January 12, 2001 (now U.S. Patent 6,512,119, issued Jan. 28, 2003), which in turn is a CIP of application Serial No. 09/738,793, filed December 14, 2000 (now U.S. Patent 6,663,797, issued December 16, 2003).

The Examiner contends that the listing of references in the specification is "not a proper information disclosure statement". Applicants note that all of the references listed in the specification are also listed on the Information Disclosure Statement and PTO Form 1449, filed with the application. Thus, if the Examiner has reviewed the references cited in Applicants' IDS, then he has reviewed the relevant references of which Applicants are aware. Applicants had thought that tying specific references to a discussion of the prior art would be an aid to the Examiner. Applicants could, in future applications, delete references in the specification - is this what the Examiner would prefer?

Applicants have endeavored to review the application and to make suitable corrections, as noted in the Amendments to the Specification, discussed above.

The Examiner indicates that Claims 6, 8, 10, 18-19, and 21-25 are objected to as being dependent upon a rejected base claims, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Applicants appreciate the allowability of these claims, but for the reasons and arguments presented below, urge that the remaining claims are also allowable.

The Examiner indicates that Claims 3-10 and 18-25 would be allowable upon overcoming the claim objections, if rewritten in independent form including all of the limitations of the base claim and any intervening claims, and/or provisional rejections under obviousness double

patenting. Applicants appreciate the allowability of these claims, but for the reasons and arguments presented below, urge that the remaining claims are also allowable.

Claims 1-2, 5, 12, 16-17, and 27 are rejected under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. The various rejections are dealt with serially.

(A) The Examiner objects to the term “substantial conjugation” in Claims 1-2, 5, and 16-17 as being a relative term. The Examiner contends that “neither the claims nor specification provide any guidance in establishing the metes and boundaries of this limitation ...”

Applicants respectfully disagree. Paragraphs [0069]-[0071] specifically disclose “a molecule system that comprises an electric (E) field induced change of substantial conjugation via chemical bonding change. The change of substantial conjugation may be accomplished in one of the following ways:

(1) charge separation or recombination accompanied by increasing or decreasing molecular electronic state localization; or

(2) change of an extent of the conjugation of the molecular electronic states via charge separation or recombination and  $\pi$ -bond breaking or making.”

Nevertheless, in the interests of advancing the prosecution, the word “substantial” is deleted in Claims 1, 2, 5, 16, 17, and 20.

(B) The Examiner objects to the terms “relatively smaller” and “relatively larger” in Claims 1 and 16 as being a relative term that renders the claims indefinite.

Applicants respectfully disagree. The terms are used within a single claim to specify that one parameter (band gap) is larger in one case and smaller in another case. That is, the comparison of one to the other is relative. This is far different than a statement that a parameter is “high” or “large”, which, of course, is unacceptable. Applicants know of no basis to object to a comparison between two parameters in the same claim. Nevertheless, in the interests of advancing the prosecution, the terms are deleted, and instead, there is a recitation of a first band gap (conjugation) and a second band gap (changed conjugation), where the second band gap is larger than the first band gap.

(C) The Examiner objects to the term “low activation” in Claims 12 and 27.

Applicants have amended the phrase “a low activation barrier between different states to provide a fast, but volatile, switch” to read “an activation barrier between different states that is sufficiently low to provide a fast, but volatile, switch”. Applicants assert that, based on

their teachings, one skilled in the art would be able to determine the value of the activation barrier. While some experimentation might be involved, such experimentation is not considered to be undue.

(D) The Examiner objects to the phrase “conjugation is destroyed” in Claims 1 and 16 as rendering the claims indefinite. The Examiner contends that it is unclear whether the limitation(s) following the phrase are part of the claimed invention. Further, the Examiner contends that it is not clear whether the conjugation is destroyed irreversibly and is still functional or it changes reversibly with the applied field.

First, the word “destroyed” is replaced with the word “changed”. Basis for this change is found on page 14, lines 21-28. See also paragraphs 0072 and 0092, for example.

Second, the phrase following the phrase “conjugation is changed” reads “, resulting in a relatively larger (now amended to read “second”) band gap”. As described in the specification in, for example, paragraphs 0072, 0092, 0114-0115, and 0126-0128, if the molecule is conjugated, there is a relatively lower band gap energy. If the conjugation is reduced (changed), then the band gap energy increases. Thus, the limitations following the phrase are part of the claimed invention.

Third, as described in the specification in paragraph 0056, the change in conjugation is preferably reversible. This reversibility feature is what permits change of color in a display as a function of the applied field. However, there are instances where it may be desirable to have a situation in which the change in conjugation is irreversible.

The Examiner is correct in assuming the change to be reversible upon the application of an electric field. Actually, to be more precise, the change is reversible upon the reversal of the electric field, wherein in a first direction, the molecule is oriented with the field in such a way as to be conjugated (smaller band gap state) and with a reversal of the field, the conjugation is diminished (larger band gap state), due to, for example, separating and recombining of separated charges (paragraph 0072) or breaking and re-connecting of  $\pi$ -bonds (paragraph 0092).

Reconsideration of the rejection of Claims 1-2, 5, 12, 16-17, and 27, as amended, under 35 USC 112, second paragraph, is respectfully requested.

Claims 1-2, 5, 11-17, 20, and 26-30 are rejected under 35 USC 102(e) as being anticipated by Li et al (U.S. Patent 6,579,630).

Li et al disclose deuterated semiconducting organic compounds used for opto-electronic devices. Organic semiconductors consisting of conjugated chromophores wherein one or more

hydrogen atoms are deuterated are disclosed. The organic semiconducting compounds are said to exhibit improved optical and electronic properties.

Applicants' Claim 1, as amended, recites a switchable medium for a visual display comprising an electric field activated molecular system configured within an electric field generated by a pair of electrodes, the molecular system having an electric field induced band gap change that occurs via a reversible or irreversible change of extent of the electron conjugation in the molecule via chemical bonding change to change the band gap, wherein in a first state, there is conjugation throughout the molecular system, resulting in a first band gap, and wherein in a second state, the conjugation is changed, resulting in a second band gap, where the second band gap is larger than the first band gap.

Claims 2-15 depend, directly or indirectly, from Claim 1.

Applicants' independent Claim 16, as amended, recites an electronic ink including an electric field activated molecular system configured within an electric field generated by a pair of electrodes, the molecular system having an electric field induced band gap change that occurs via a reversible or irreversible change of extent of the electron conjugation in the molecule via chemical bonding change to change the band gap, wherein in a first state, there is conjugation throughout the molecular system, resulting in a first band gap, and wherein in a second state, the conjugation is changed, resulting in a second band gap, wherein the second band gap is larger than the first band gap.

Claims 17-30 depend, directly or indirectly, from Claim 16.

The Li invention is a conventional polymer-LED, wherein an electric field is used to transport electrons and holes into a polymeric layer. The electrons and holes recombine within the polymer to create photons. This approach significantly differs from Applicants' technology. Applicants' materials do not transport charge as a mechanism for producing the desired optical effect. Such charge transport in polymer and organic LEDs causes charge traps and chemical reactions that dramatically impact the operating longevity of the LED devices. In contrast, Applicants' materials employ an structural rearrangement within the molecule to change the state of conjugation to obtain the desired change in HOMO-LUMO gap. There is no such structural rearrangement in the device of Li et al, which rather teaches a net change in the number of atoms in the molecule as a result of the chemical reaction.

The Examiner argues that Li et al teach compositions of semiconducting organic compounds and optoelectronic devices containing the semiconducting organic compounds sand-

wiched between two electrodes, wherein upon the application of the electric field, the charge transfer takes place, leading to the emission of light, citing Col. 1, lines 45-58.

In point of fact, the cited portion is background art to the Li et al reference, and is directed to the description of OLEDs for which the semiconductor compounds of Li et al are suitable.

The Examiner next states that the semiconducting compounds contain conjugated chromophores, wherein the band gap of the organic compound decreases from 3.42 eV to 2.45 eV “with concomitant increase in conjugation” resulting in the fluorescence emission of green light, citing Col. 15, line 66 to Col. 16, line 5, and FIG. 4.

Applicants note that Li et al are deuterating their organic semiconducting compounds. These compounds in the fully hydrogen-containing state are conjugated. Deuteration does not alter the conjugation. Any optical and/or electronic effects that are observed are due to the fact that deuterium is heavier than hydrogen, and NOT due to any diminishment of conjugation. That the deuteration has no effect on conjugation is seen, for example, at Col. 4, lines 54-63, wherein the deuteration of one or more hydrogen atoms on a *conjugated* chromophore is described. That the chromophore is conjugated after deuteration is apparent from the next paragraph in the description of deuterated structures that may be used to form *conjugated* chromophores. Thus, deuteration does not affect the conjugation of an already conjugated molecule.

The Examiner’s cited portion (Col. 15, line 66 to Col. 16, line 5) is actually directed to the conversion of polymer 6 (a sulfonium polymer, called sulfonium-precursor deuterated PPV, or poly(phenylene vinylene)) to polymer 7 (deuterated PPV) via a chemical reaction. There is a change in conjugation length, but this is because a precursor polymer is being irreversibly converted to a polymer. The same effect would likely be observed even in the non-deuterated synthesis; see, e.g., Col. 16, lines 39-48. Such a conversion from the precursor to the final polymer is NOT carried out in the presence of an electric field. What is placed between the electrodes and exposed to the electric field as a device is polymer 7.

It is true that the UV spectra were measured for both the precursor polymer and the PPV polymer (both deuterated), as shown in FIG. 3. FIG. 4 shows the green fluorescence *after conversion*. There is absolutely no disclosure or suggestion by Li et al of reversible conversion between polymers 6 and 7. Even if such a reversible conversion were carried out, it would be via a chemical reaction, and not via a structural rearrangement.

Further, there is absolutely no disclosure or suggestion of any mechanism by which the conjugation of the deuterated (or even the non-deuterated) compounds is destroyed/changed/diminished. Applicants' approach is to take an essentially fully conjugated molecule that, in the presence of an electric field remains in that conjugation, but in the presence of a reverse field, there is a change of conjugation that is either (1) accomplished by charge separation or recombination accompanied by increasing or decreasing molecular electronic state localization or (2) accomplished by change of extent of the conjugation of the molecular electronic states via charge separation or recombination and  $\pi$ -bond breaking or making. The molecule is no longer conjugated from one end to the other, but rather experiences a break in conjugation. In the former state, the band gap energy is lower than in the latter state. No conventional chemical reaction occurs (by which is meant an increase or decrease in the number of atoms in the molecule).

Interestingly, the Examiner argues that Li et al go from a higher band gap (3.42 eV) to a lower band gap (2.45 eV) with a concomitant *increase* in conjugation. Applicants' claims are directed to the reverse situation: a decrease in conjugation results in an increased band gap as a result of the structural rearrangement.

The significant difference between the disclosure of Li et al and Applicants' claimed invention relative to "conjugation change" is that one occurs through a chemical reaction (Li et al), while the other (Applicants) occurs through a simple structural rearrangement. Figures 6 and 7 in the Li et al patent clearly show that the conformation change has occurred through the elimination of a thiophene. Chemical reaction is, of course, the conventional mechanism by which conjugation change occurs. The advantage of Applicants' claimed changed conjugation via structural rearrangement is exactly that *no* chemical reaction occurs, or is necessary. Chemical reactions have side reaction risks that eventually destroy or, otherwise hinder, the function of the molecule.

Thus, Li et al utterly fail to disclose a change (diminishment) in band gap energy upon the reversal of an electric field. Li et al utterly fail to disclose an increase in band gap energy as conjugation is diminished in an organic molecule. And Li et al utterly fail to disclose reversibility with such a system as claimed by Applicants.

Finally, Li et al are totally silent on two preferred ways to alter, or change, the conjugation, namely, wherein in one case, the molecule is oriented with the field in such a way as to be conjugated (smaller band gap state) and wherein in the other case, there is a reversal of the field, such that the conjugation is diminished (larger band gap state), due to, for example, (1) separat-

ing and recombining of separated charges (Claims 2 and 17) or breaking and re-connecting of  $\pi$ -bonds (Claims 5 and 20). Li et al carry out an irreversible **chemical** reaction, which, as stated above, is completely different than a **structural rearrangement**.

For the foregoing reasons, Li et al fail to disclose or even remotely suggest each and every feature of Applicants' claimed invention. Nothing in Applicants' claims is met inherently by Li et al.

Reconsideration of the rejection of Claims 1-2, 5, 11-17, 20, and 26-30, as amended, under 35 USC 102(e) as being anticipated by Li et al is respectfully requested.

Claims 1-5, 7, 9, and 11-15 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 1-3, 8-15, 17-18, and 20-28 of pending application Serial No. 09/844,862.

The present application is a continuation-in-part of the '862 application, as noted in paragraph 0001 of the specification. In the interests of advancing the prosecution, a Terminal Disclaimer, executed by Susan E. Heminger on behalf of the Assignee, is enclosed herewith.

Reconsideration of the provisional rejection of Claims 1-5, 7, 9, and 11-15 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 1-3, 8-15, 17-18, and 20-28 of pending application Serial No. 09/844,862 is respectfully requested.

Claims 16-17, 20, and 26-30 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 17-18 and 24-32 of pending application Serial No. 09/898,799.

The present application is related to the '862 application, as noted in paragraph 0002 of the specification. In the interests of advancing the prosecution, a Terminal Disclaimer, executed by Susan E. Heminger on behalf of the Assignee, is enclosed herewith.

Reconsideration of the provisional rejection of Claims 16-17, 20, and 26-30 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 17-18 and 24-32 of pending application Serial No. 09/898,799 is respectfully requested.

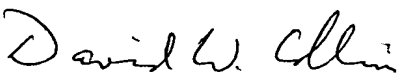
The Examiner states that there are other related applications (09/846,135, 09/823,195, and 10/187,720) with obvious double patent issues. However, in the absence of any rejection, Applicants have no response to the Examiner's statement. In particular, the last cited application is later in time than the present application, so any rejection should properly be done through that application.

The Examiner cites Gharavi (US Publ 2002/0009274) as being pertinent to Applicants' disclosure. Applicants have reviewed this reference and consider that it neither discloses nor suggests their invention, whether taken alone or in combination with any of the references discussed above.

The foregoing amendments and arguments are submitted to place the application in condition for allowance. (original) The Examiner is respectfully requested to take such action. If the Examiner has any questions, he is invited to contact the undersigned at the below-listed telephone number. HOWEVER, ALL WRITTEN COMMUNICATIONS SHOULD CONTINUE TO BE DIRECTED TO: IP ADMINISTRATION, LEGAL DEPARTMENT, M/S 35, HEWLETT-PACKARD COMPANY, P.O. BOX 272400, FORT COLLINS, CO 80527-2400.

Respectfully submitted,

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